

[Please cancel claim 82 without prejudice.

D₁ ~~83~~¹ (amended) An interface apparatus as recited in claim ~~86~~¹ further comprising an electronically-controllable actuator coupled to said linkage and able to apply a force along at least one of said at least two degrees of freedom to said user manipulatable object through said unitary member.

~~86~~ (amended) An interface apparatus for interfacing motion of a user with a computer system, said interface apparatus comprising:

a user manipulatable object physically contacted by said user and moveable by said user in at least two rotary degrees of freedom;

D₂ a linkage coupled to said user manipulatable object and providing said at least two rotary degrees of freedom to said user manipulatable object, each rotary degree of freedom being about an axis of rotation, said linkage including a plurality of members, wherein a selected number of said plurality of members have been formed as a unitary member in which flex is provided between said selected number of members, said flex permitting motion between said selected number of members that allows motion of said user manipulatable object in at least one of said rotary degrees of freedom, wherein said plurality of members of said linkage are formed as a closed-loop linkage in which said members are flexibly coupled to each other as segments of said unitary member; and

at least one sensor able to detect a position or motion of said user manipulatable object along said at least two degrees of freedom and outputting sensor signals, wherein said sensor signals, or a representation thereof, are received by said computer system.

[88. An interface apparatus as recited in claim 86 wherein said closed loop linkage includes:

a ground member coupled to a ground surface;

first and second extension members, each extension member being coupled to said ground member; and

first and second central members, said first central member having an end coupled to said first extension member and said second central member having an end coupled to said second extension member, wherein said central members are coupled to each other at ends not coupled to said extension members and wherein at least one of said central members is coupled to said user manipulatable object, said central members coupled to each other approximately at said coupling of said user manipulatable object to said at least one of said central members.

89. An interface apparatus as recited in claim 88 wherein said central members are coupled to an object member which is coupled to said user manipulatable object.

90. An interface apparatus as recited in claim 88 wherein said first and second central members are flexible and wherein said first and second central members and said first and second extension members are flexibly coupled to each other and form said unitary member.

91. An interface apparatus as recited in claim 88 wherein said ground member is rotatably coupled to said first and second extension members by bearings, said bearings allowing said first and second extension members to be rotated about said axes of rotation.

92. An interface apparatus as recited in claim 86 wherein at least one of said members flexibly coupled in said unitary member is relatively narrow in a dimension in which said member is desired to flex, and is relatively wide in other dimensions in which said member is desired to be stiff.

93. An interface apparatus as recited in claim 83 wherein said actuator is a first actuator coupled to a ground member, and further comprising a second actuator coupled to a ground member of said linkage, said second actuator being operative to apply a force in a degree of freedom to said user manipulatable object in response to signals received from said computer system.

94. An interface apparatus as recited in claim 88 wherein said central members are flexibly coupled to an object member which is coupled to said user manipulatable object.

95. An interface apparatus as recited in claim 88 wherein said end of said first central member is flexibly coupled to said first extension member, and said end of said second central member is flexibly coupled to said second extension member.

96. An interface apparatus as recited in claim 88 wherein said two axes of rotation are fixed with respect to said ground member, said first and second extension members being rotatable about said fixed axes of rotation, and wherein said central members are rotatable about first and second floating axes, said floating axes being movable with respect to said ground member.

97. (amended) An interface apparatus as recited in claim ~~86~~ wherein said user manipulatable object is a joystick handle.

98. An interface apparatus as recited in claim 83 wherein said actuator includes a voice coil actuator for imparting a force on said user object using magnetic fields and controlled by an electrical current.

99. A flexure linkage for providing motion to a user manipulatable object of an interface device, said interface device in communication with a computer system, said flexure linkage comprising:

a first member coupled to said user manipulatable object;

a second member coupled to said first member, wherein flex is provided between said second member and said first member; and

a third member coupled to said first member, wherein flex is provided between said third member and said first member, and wherein said first, second and third members form a unitary member;

wherein said flexure linkage provides at least two rotary degrees of freedom to said user manipulatable object about axes of rotation with respect to a ground such that said user manipulatable object can be moved by a user in said at least two rotary degrees of freedom and a position of said user manipulatable object in said two rotary degrees of freedom can be provided to said computer system.

* Please cancel claims 102 and 103 without prejudice.

104. A flexure linkage as recited in claim 99 wherein said first and second members are coupled to an object member which is coupled to said user manipulatable object.

105. A flexure linkage as recited in claim 99 wherein at least one of said members flexibly coupled in said unitary member is relatively narrow in a dimension in which said member is desired to flex, and is relatively wide in other dimensions in which said member is desired to be stiff.

* Please cancel claim 106 without prejudice.

107. (amended) A method as recited in claim 110 further comprising applying a force along at least one of said at least two degrees of freedom to said user manipulatable object through said unitary member.

110. (amended) A method for interfacing motion of a user manipulatable object with a computer system, the method comprising:

providing said user manipulatable object physically contacted by a user and moveable by said user;

providing a linkage including a plurality of members wherein said plurality of members of said linkage are formed as a closed-loop linkage, wherein said plurality of members of said linkage are formed as a closed-loop linkage;

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cont.
providing flex between a selected number of said members to provide at least two rotary degrees of freedom to said user manipulatable object about axes of rotation, wherein said selected number of members are formed as a unitary member; and

sensing a position or motion of said user manipulatable object in said at least two rotary degrees of freedom and outputting sensor signals, wherein said sensor signals, or a representation thereof, are received by said computer system.

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111. (amended) A method as recited in claim 110 wherein said axes of rotation are fixed with respect to a ground member of said plurality of members, wherein said plurality of members includes first and second extension members and a first central member coupled to said first extension member and a second central member coupled to said second extension member, wherein said first and second extension members being rotatable about said fixed axes of rotation, and wherein said central members are rotatable about first and second floating axes, said floating axes being movable with respect to said ground member.

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* Please cancel claim 112 without prejudice.